Chapter 1: Characteristics and Classification of Living Organisms

1.1 Characteristics of Living Organisms

All living organisms exhibit a set of common characteristics that distinguish them from non-living matter. These are often summarized by the acronym **MRS GREN**.

- **Movement**: This is an action by an organism or part of an organism that results in a change of position or place.
- **Respiration**: These are the chemical reactions that occur in the cells of living organisms to break down nutrient molecules and release energy for metabolism.
- **Sensitivity**: This is the ability of an organism to detect and respond to changes in its internal or external environment.
- **Growth**: This is a permanent increase in the size and dry mass of an organism, which is achieved through an increase in cell number, cell size, or both.
- **Reproduction**: This is the process of making more of the same kind of organism.
- **Excretion**: excretion as the removal of the waste products of metabolism and substances in excess of requirements
- **Nutrition**: This is the intake of materials for energy, growth, and development.

1.2 Concept and Uses of Classification Systems

The Purpose of Classification

Classification is the systematic grouping of living organisms based on their shared features. This is essential for several reasons:

- **Organization**: It helps to organize the vast diversity of life in a structured and logical manner.
- **Identification**: It allows for the easy identification of known species and the recognition of new ones.
- **Evolutionary Relationships**: Modern classification systems aim to reflect the evolutionary relationships between different species. Organisms that share a more recent common ancestor are grouped more closely together.

The Binomial System of Nomenclature

The **binomial system**, developed by Carl Linnaeus, is the internationally agreed-upon method for naming species. Each species is assigned a unique two-part scientific name:

- The first name is the **genus**, which is always capitalized.
- The second name is the **species**, which is always in lowercase.
- The entire name is written in *italics*, for example, *Homo sapiens*.

The Hierarchy of Classification

Organisms are classified into a series of hierarchical groups called **taxonomic ranks**. The main ranks, from the broadest to the most specific, are:

- **Kingdom**
- **Phylum**
- **Class**
- **Order**
- **Family**
- **Genus**
- **Species**

The Use of DNA in Classification

Advances in genetics have revolutionized classification. The sequences of bases in an organism's **DNA** are now used as a primary means of classification. The **more similar** the DNA sequences are between two organisms, the more closely they are related in evolutionary terms. This is because they share a more recent common ancestor.

Dichotomous Keys

A **dichotomous key** is a practical tool used for identifying organisms. It consists of a series of paired, contrasting statements. By selecting the statement that best describes the organism at each step, one can progressively narrow down the possibilities until the organism is identified.

1.3 Features of Organisms

The Five Kingdoms of Life

Living organisms are classified into five kingdoms based on their cellular structure and nutritional methods:

1. **Animals**: Multicellular, eukaryotic organisms. Their cells have a nucleus but lack cell walls and chloroplasts. They are heterotrophic, meaning they ingest organic matter for nutrition.
2. **Plants**: Multicellular, eukaryotic organisms. Their cells have a nucleus, a cellulose cell wall, and chloroplasts for photosynthesis. They are autotrophic, producing their own food.
3. **Fungi**: Mostly multicellular (except for yeast), eukaryotic organisms. Their cells have cell walls made of chitin, not cellulose. They are saprophytic, meaning they secrete enzymes to digest food externally and then absorb the nutrients.

4 **Protoctists**: Mostly unicellular, eukaryotic organisms. This is a diverse group that includes organisms that have features of animals (Protozoa), plants (algae), or fungi.
5 **Prokaryotes**: Unicellular organisms that lack a true nucleus and membrane-bound organelles. Their genetic material is located in the cytoplasm. This kingdom includes bacteria.

The Animal Kingdom: Vertebrates and Arthropods

The animal kingdom is divided into numerous phyla. Two major groups are vertebrates and arthropods.

Vertebrates

Vertebrates are animals with a backbone. The main classes of vertebrates are:

- **Mammals**: Have fur or hair, External ears (pinna) , have a placenta, and females have mammary glands to produce milk. They give birth to live young.
- **Birds**: Have feathers, a beak, and wings. They lay eggs with hard shells.
- **Reptiles**: Have dry, scaly skin, are cold-blooded, and lay eggs with leathery shells on land.
- **Amphibians**: Have smooth, moist skin, are cold-blooded, and lay eggs in water. Their larvae (tadpoles) have gills, while adults have lungs (metamorphic life cycle).
- **Fish**: Have scales and fins, are cold-blooded, and breathe using gills.

Arthropods

Arthropods are invertebrates with a segmented body, jointed limbs, and an exoskeleton. The main classes of arthropods are:

- **Myriapods**: Have a body consisting of many segments, with each segment having one or two pairs of legs (e.g., centipedes and millipedes),one pair of antennae, and a hard exoskeleton.
- **Insects**: Have a body divided into three parts (head, thorax, and abdomen), with three pairs of legs, one pair of antennae, and often wings.
- **Arachnids**: Have a body divided into two parts (cephalothorax and abdomen), with four pairs of legs and no antennae (e.g., spiders and scorpions) .
- **Crustaceans**: Have a body with more than four pairs of jointed legs and two pairs of antennae (e.g., crabs and lobsters).

The Plant Kingdom: Ferns and Flowering Plants

The plant kingdom is divided into several groups, including ferns and flowering plants.

- **Ferns**: Have leaves called fronds. They do not produce flowers but reproduce by means of spores produced on the underside of the fronds.

- **Flowering Plants**: Reproduce by seeds that are produced by flowers. They are divided into two major groups:
    - **Monocotyledons (Monocots)**: Have one cotyledon (seed leaf), parallel leaf veins, and flower parts in multiples of three.
    - **Dicotyledons (Dicots)**: Have two cotyledons, branching leaf veins, and flower parts in multiples of four or five.

Viruses

Viruses are not classified in any of the five kingdoms because they are not considered to be living organisms(Do not respire, excrete, move etc). They are non-cellular and can only reproduce by infecting living cells(host). A virus consists of a core of genetic material (either DNA or RNA) surrounded by a protein coat called a **capsid**.